

WHAT IS CLAIMED IS:

1. A gray level reproduction method which makes one-to-one correspondence between each pixel of an original image and each element of a threshold matrix,  
5 and represents a density of each pixel in an output image by binary or multivalued,

wherein said threshold matrix is created according to following conditions:

(1) when a dot pattern of which the size  
10 corresponds to the threshold matrix is divided into small blocks, the number of dots in each of all the blocks is made equal in all gray levels;

(2) the dot patterns in the plural blocks are made mutually the same in all the gray levels; and

15 (3) at a boundary of the blocks where the dot patterns are made mutually the same, the dots are increased while taking conformity of the dot patterns.

2. A method according to Claim 1, wherein the sum  
20 of averaged repulsion potentials is used to take the conformity of the dot patterns.

3. A method according to Claim 1 or 2, wherein said threshold matrix is created by controlling order  
25 of dot increase between the blocks where the dot patterns are made mutually the same and the other blocks.

4. A method according to Claim 3, wherein the blocks where the dot patterns are made mutually the same are preferential as the order of dot increase.

5 5. A method according to Claim 1, wherein, when the dot pattern is determined, a repulsion potential is assigned to each dot to control a distance between the dots.

10 6. A method according to Claim 1, wherein, in a case where the dot pattern is determined, when the block is further divided into four smaller blocks, the number of dots in each of all the smaller blocks is made equal in  $4n$  gray levels ( $n$  is an integer).

15 7. A method according to Claim 1, wherein, when the threshold matrix is repeatedly used two-dimensionally and periodically, a repeat direction is being diverted to either a longitudinal direction or a lateral direction.

8. A method according to Claim 1, wherein a shape of the threshold matrix is different from a square.

25 9. A method according to Claim 1, wherein a color image is decomposed into plural color components, and the original image of at least one color component is

input as an input image.

10. A gray level reproduction method which makes one-to-one correspondence between each pixel of an original image and each element of a threshold matrix, and represents a density of each pixel in an output image by binary or multivalued,

wherein said threshold matrix is created according to following conditions:

- (1) when a dot pattern of which the size corresponds to the threshold matrix is divided into small blocks, the number of dots in each of all the blocks is made equal in all gray levels;
- (2) the dot patterns in the plural blocks are made mutually the same in all the gray levels; and
- (3) order of dot increase is controlled between the blocks where the dot patterns are made mutually the same and the other blocks.

11. A method according to Claim 10, wherein the blocks where the dot patterns are made mutually the same are preferential as the order of dot increase.

12. A method according to Claim 10, wherein, when the dot pattern is determined, a repulsion potential is assigned to each dot to control a distance between the dots.

13. A method according to Claim 10, wherein, in a case where the dot pattern is determined, when the block is further divided into four smaller blocks, the number of dots in each of all the smaller blocks is  
5 made equal in  $4n$  gray levels ( $n$  is an integer).

14. A method according to Claim 10, wherein, when the threshold matrix is repeatedly used two-dimensionally and periodically, a repeat direction is  
10 being diverted to either a longitudinal direction or a lateral direction.

15. A method according to Claim 10, wherein a shape of the threshold matrix is different from a  
15 square.

16. A method according to Claim 10, wherein a color image is decomposed into plural color components, and the original image of at least one color component  
20 is input as an input image.

17. A gray level reproduction apparatus which makes one-to-one correspondence between each pixel of an original image and each element of a threshold  
25 matrix, and represents a density of each pixel in an output image by binary or multivalued, wherein, when a dot pattern of which the size corresponds to said

threshold matrix is divided into small blocks, the number of dots in each of all the blocks is made equal in all gray levels, and the dot patterns in the plural blocks are made mutually the same in all the gray  
5 levels, said apparatus comprising:

storage means for storing said threshold matrix;

comparison means for comparing as a threshold the value of said threshold matrix with the density of each pixel of the original image for each pixel; and

10 output means for outputting the binary- or multivalue-processed dot pattern according to the comparison result of said comparison means,

wherein, at a boundary of the blocks where the dot patterns are made mutually the same, said threshold  
15 matrix is created such that the dots are increased while taking conformity of the dot patterns.

18. An apparatus according to Claim 17, wherein said threshold matrix is created by controlling order  
20 of dot increase between the blocks where the dot patterns are made mutually the same and the other blocks.

19. A gray level reproduction apparatus which  
25 makes one-to-one correspondence between each pixel of an original image and each element of a threshold matrix, and represents a density of each pixel in an

output image by binary or multivalue, wherein, when a dot pattern of which the size corresponds to said threshold matrix is divided into small blocks, the number of dots in each of all the blocks is made equal  
5 in all gray levels, and the dot patterns in the plural blocks are made mutually the same in all the gray levels, said apparatus comprising:

storage means for storing said threshold matrix;

comparison means for comparing as a threshold the  
10 value of said threshold matrix with the density of each pixel of the original image for each pixel; and

output means for outputting the binary- or multivalue-processed dot pattern according to the comparison result of said comparison means,

15 wherein said threshold matrix is created by controlling order of dot increase between the blocks where the dot patterns are made mutually the same and the other blocks.

20 20. A threshold matrix which is used to be compared with each pixel of an original image to represent a density of each pixel in an output image by binary or multivalue, and created according to following conditions:

25 (1) when a dot pattern of which the size corresponds to the threshold matrix is divided into small blocks, the number of dots in each of all the

blocks is made equal in all gray levels;

(2) the dot patterns in the plural blocks are made mutually the same in all the gray levels; and

(3) at a boundary of the blocks where the dot  
5 patterns are made mutually the same, the dots are increased while taking conformity of the dot patterns.

21. A threshold matrix according to Claim 20,  
wherein said threshold matrix is created by controlling  
10 order of dot increase between the blocks where the dot patterns are made mutually the same and the other blocks.

22. A threshold matrix which is used to be  
15 compared with each pixel of an original image to represent a density of each pixel in an output image by binary or multivalued, and created according to following conditions:

(1) when a dot pattern of which the size  
20 corresponds to the threshold matrix is divided into small blocks, the number of dots in each of all the blocks is made equal in all gray levels;

(2) the dot patterns in the plural blocks are made mutually the same in all the gray levels; and

(3) order of dot increase between the blocks where  
25 the dot patterns are made mutually the same and the other blocks is controlled.

23. A storage medium which computer-readably stores a control program to control a gray level reproduction process which makes one-to-one correspondence between each pixel of an original image and each element of a threshold matrix and represents a density of each pixel in an output image by binary or multivalued, wherein, when a dot pattern of which the size corresponds to said threshold matrix is divided into small blocks, the number of dots in each of all the blocks is made equal in all gray levels, and the dot patterns in the plural blocks are made mutually the same in all the gray levels, said storage medium comprising:

the threshold matrix which is created, at a boundary of the blocks where the dot patterns are made mutually the same, such that the dots are increased while taking conformity of the dot patterns;

a module for performing control to compare as a threshold the value of said threshold matrix with the density of each pixel of the original image for each pixel, and output the binary- or multivalued-processed dot pattern according to the comparison result.

24. A storage medium according to Claim 23, wherein said threshold matrix is created by controlling order of dot increase between the blocks where the dot patterns are made mutually the same and the other

blocks.

25. A storage medium which computer-readably stores a control program to control a gray level reproduction process which makes one-to-one correspondence between each pixel of an original image and each element of a threshold matrix and represents a density of each pixel in an output image by binary or multivalued, wherein, when a dot pattern of which the size corresponds to said threshold matrix is divided into small blocks, the number of dots in each of all the blocks is made equal in all gray levels, and the dot patterns in the plural blocks are made mutually the same in all the gray levels, said storage medium comprising:

the threshold matrix which is created by controlling order of dot increase between the blocks where the dot patterns are made mutually the same and the other blocks; and

a module for performing control to compare as a threshold the value of said threshold matrix with the density of each pixel of the original image for each pixel, and output the binary- or multivalued-processed dot pattern according to the comparison result.